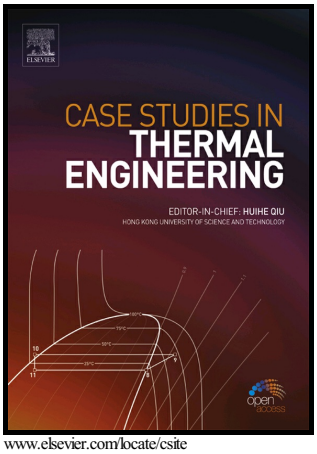
Author's Accepted Manuscript



www.elsevier.com/locate/csite

Numerical investigation of heat transfer from multi–bulges pins

Amr Owes Elsayed

PII: S2214-157X(18)30066-2
DOI: https://doi.org/10.1016/j.csite.2018.08.005
Reference: CSITE326

To appear in: *Case Studies in Thermal Engineering*

Received date: 11 March 2018
Revised date: 8 August 2018
Accepted date: 21 August 2018

Cite this article as: Amr Owes Elsayed, Numerical investigation of heat transfer from multi–bulges pins, *Case Studies in Thermal Engineering,* https://doi.org/10.1016/j.csite.2018.08.005

Numerical investigation of heat transfer from multi–bulges pins

Amr Owes Elsayed

Department of Mechanical Power Engineering, Faculty of Engineering, Zagazig University, Egypt

amro9992000@yahoo.com

ABSTRACT

This paper presents an attempt to improve the thermal performance of the absorber plate in photovoltaic solar systems by introducing novel configurations of pin fins. The cross-sectional area of these pins varies along the pin length producing small bulges with regular geometric shapes. The objective of changing the pin profile is to increase the heat transfer area and to produce a better mixing effect in the passages of the cooling fluid. Three shapes of bulges (diamond, cylinder and circular rings) have been employed to produce three forms of multi-bulges pin. The novel pins have been investigated under the influence of steady laminar forced convection flow. The effect of fin design on the absorber heat dissipation behavior has been studied and reported. The numerical model has been carried out by using CFD Fluent software. Finite volume technique is used and SIMPLE algorithm is applied. The thermal performance is presented in terms of surface temperatures of fin and plate, thermal efficiency of the absorber and average Nusselt number. In comparison with conventional pin fins, the results showed that the proposed pin fins indicate a good insight in the heat dissipation process and more effective in thermal performance.

KEY WORDS

Photovoltaic thermal collectors, Pin fins, bulges pins, Absorber thermal efficiency

Nomenclature

A_p	area of absorber plate, m^2
A_s	surface area of pin, m^2
c_p	specific heat, J/ kg K
d	diameter, m
D_{hy}	$[2\,h\,w / (h + w)]$ hydraulic diameter of air channel, m
h	convective heat transfer coefficient, W/m^2 K
h	channel height, m
I	solar irradiance, W/m^2
k	thermal conductivity, W/m K
ℓ	pin length, m
m	mass flow rate of air, kg/s
Nu	Nusselt number
Q	power applied on the absorber, W
Re	Reynolds number
T	temperature, K or ºC
T_p	average temperature of the absorber plate, ºC